Exhibit 7

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an NTT DATA Company

everis Connected Car Report

A brief insight on the connected car market, showing possibilities and challenges for third-party service providers by means of an application case study

Part ONE

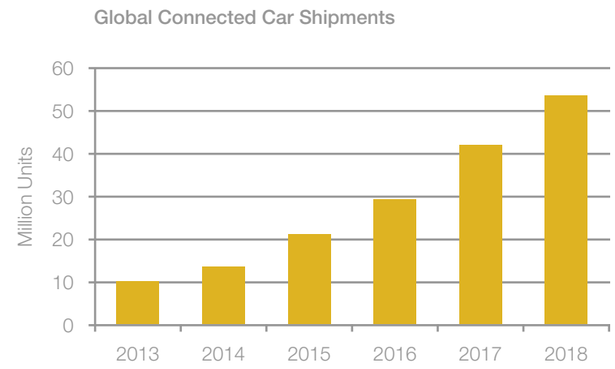
State of the Art

1. Definition and Setup

The connected car provides the possibility of internet-based data transfer between the car and its surroundings. The internet connection is provided either through a built-in communication module or other devices, such as smartphones. Within the scope of this report the phrase “Connected Car” in fact refers to the component, which consists of both the physical hardware and the software, which is necessary for internet-based services. The hardware usually consists of head unit, display, human machine interface (HMI) and in some cases also a telematics control unit (TCU). The combination of these different parts allow for the implementation of the software component, in terms of applications and services, which are extensively described in this report.

2. The Connected Car Market

Market analysts coincide in the fact that connected cars will achieve mass-market penetration in the next couple of years. The overall number of vehicles with built-in internet connectivity will increase from 10% of the overall market today to 90% by the end of the decade[1]. The demand for connected car services is unquestionable and proven by various surveys. Results show that 80% of interviewees expect the connected car to provide the same connected experience they are used to at home, at work and via mobile device[2].



The market share for connected cars was investigated by various studies[3]. Results can be seen in previous chart.

The connected car has the potential of making lives more convenient, journeys greener and roads safer. This is also why the development of these technologies are mandated and supported by politics at the highest level. Back in 2008 the European Commission published an action plan for the deployment of intelligent transport systems in road transport, with the goal of making road travelling more efficient and safer[4]. These efforts resulted in a mandate for all cars sold in the EU by 2015 to be equipped with an automatic emergency call in case of a crash. This kind of mandated telematics exists also in other countries such as Brazil and Russia and it is, next to customer demand, one of the key drivers of the connected car market.

[1] Telefónica – Connected Car Industry Report 2014
[2] Telefónica – Connected Car Industry Report 2014
[3] ABI Research, BI Intelligence, GSMA
[4] http://eur-lex.europa.eu/legal-content/EN/ALL/;ELX_SESSIONID=24ZhJtyhLZjxkwyklLCVZnT5GZfBXJMTtLKw1B2GTNmnyl2QV83v!397506505?uri=CELEX:52008DC0886

3. Connected Car Services

From the user point of view, connected car services can be divided into five different categories. **Traffic safety** services offer assistance for the driver not only in case of an accident or breakdown, but also if the vehicle gets stolen or for parental control issues. The owner of the car, for example, can receive notifications if his car is driven above a certain speed or outside a pre-defined area. The **infotainment** category combines all kinds of data usage for pleasure and information reasons, such as music streaming and social media interaction. Connected services in the field of navigation and traffic are among the highest demanded. Most of them require real-time information and are listed in the **traffic efficiency** section. Connected car technologies can also be used to decrease customer's oncost by implementing usage-based insurance models or smart battery charging solutions for electrical vehicles. These services are discussed in the **cost efficiency** category. Apart from the infotainment field, there are a number of convenience applications which are listed in **convenience and interaction**, because they are based on communication either between owner and vehicle (remote services), vehicle and infrastructural device (toll collection, eco tax) or driver and a call center (concierge services). To get an overview on the classification of connected car services, the five categories are illustrated in the following graphic.

1	2	3	4	5
Traffic Safety	Connected Infotainment	Traffic Efficiency	Cost Efficiency	Convenience and Interaction
Smart SOS (eCall)	Multimedia Streaming	Traffic Info	Insurance Telematics (UBI)	Remote Control
Roadside Assistence	Personalized music streaming	Street View	Driver Behavior Monitoring	Car sharing and Rental
Stolen Vehicle Assistence	Social Media and Networking	Online Route Planning	Electric Vehicle Charging Management	Electronic Toll Collection, Road Use, Congestion Charging
Geo-fencing and Speed monitoring	In-car WiFi Networks	Map Update	Predictive Maitenance	Concierge Services
Remote Diagnostics and Maitenance		Fuel Prices	Eco Tax	Driver Profiles
		Parking Infos		

The following section gives a short explanation of the Connected Car services that were selected for benchmarking reasons. The selection is based on current offerings and customer demand.

Remote Diagnostics
Remote Diagnostics refers to the process of transmitting relevant system data to the manufacturer or a repair shop in order to allow a diagnosis of a possible vehicle malfunction. This application acts as a basis for the roadside assistance and predictive maintenance services.

Stolen Vehicle Assistance
In the case of vehicle theft, the owner can use this service to locate the vehicle. In addition, it is also possible to remotely slow down the vehicle in order to reduce the risk of high-speed chases. Likewise, a remote ignition block can be requested by the owner to prevent the stolen vehicle from being restarted once the engine has been turned off.

Geo-fencing and Speed Monitoring
The geo-fencing and speed monitoring application will notify the car owner if the vehicle exits a predefined location zone or is driven faster than a certain speed. It can be used for parental control or keeping an eye on the use of company cars.

Smart SOS
In case of an accident the smart SOS (eCall) service will transmit a data package including location, number of passengers and pre-cash dynamics to rescue forces. A voice connection can also be established in order to communicate with driver and passengers. It is expected that this application will significantly cut back the time the emergency services take to arrive and in this way save many lives, especially for accidents involving unconscious drivers and passengers.

Roadside Assistance
In case of an unexpected breakdown, the roadside assistance service offers convenient help based on location information and remote diagnostics.

Internet Browser
This service refers to an in-car internet browser on the head unit that can be used only while the vehicle is not in motion.

Wi-Fi Hotspot
This service uses a built-in Wi-Fi router to offer a high-speed internet connection, especially for passengers with mobile devices and laptops.

News Feed
News updates especially designed in order to not distract the driver while in motion.

Music Stream
The possibility of listening to music on the road provided by online radios and music streaming platforms.

Email
Provision of minimal-distraction access to email reading and writing during the drive.

Social Media
On-the-road social media updates from various platforms providing the possibility to share location and desired destination.

App Store
This service provides suitable in-car applications from various fields which can be downloaded similar to an App store used for mobile devices.

Street-View
In addition to city and street maps, this service provides photographs of various places which can be displayed on the head unit. In this way the customer can get an impression of what the destination looks like before arrival.

Traffic Information
Real-time information about the traffic situation on the desired route is provided in order to be able to calculate the fastest and most convenient route.

Online Route Planning
This service offers the possibility of planning a route on a personal computer or mobile device and consequently send it to the car. It can be used for multi-stop journeys or special route planning.

Parking Information
This connected service shows the user where to find the next free parking spot and how much it costs based on real-time data. Currently this feature is offered for a limited amount of parking areas and garages in various cities.

Insurance Telematics
Based on the driver behavior of a client, insurance companies can offer flexible usage-based fees.

Driver Behavior Monitoring
In order to encourage the customer to drive in a more efficient and sustainable way, driving habits are screened and evaluated. In some cases, this service has a game-like user experience with bonus points for eco-friendly driving.

Real-time Fuel Prices
This service finds the cheapest gas station on-route or in the user's surroundings.

Electric Vehicle Charging
The charging process of an electric vehicle can be screened and planned via a mobile application. The user can, for example, be notified when the charging level has reached a sufficient level.

Predictive Maintenance
Based on remote diagnostics, this service can help the user save time and money by monitoring the vehicle's technical status and automatically make maintenance appointments. The repair shop or garage will know which replacement parts are needed in advance and can therefore improve stock management.

Eco Tax
This service manages Eco Tax issues in a convenient and cost-saving way.

Call Center
A 24/7 service hotline assists the user in various situations, for example to find a restaurant or plan trips.

Remote Services
This service includes a series of remotely operated actions using a mobile device. These are for example locking and unlocking the car, setting the air condition or heating system to a desired temperature or checking the current fuel/charging status.

Electronic Toll Collection
With this application, road tolls can be paid in a convenient way without producing traffic jams at toll collection points.

Personal Online Platform
The online platform shows various personal information regarding the purchased vehicle. This can include real-time data about the car such as mileage etc. but also financial aspects regarding, for example, installment payments.

Car sharing
Connected cars offer the possibility of operating large car sharing fleets or managing private car sharing initiatives.

4. Connectivity Architecture

According to the Global System for Mobile Association[5] (GSMA), three categories can be defined with respect to the connectivity architecture. The three different connectivity options are: Embedded, Tethered and Integrated. The use of these different connectivity options differ across the various in-car services. It is important to note that these three connectivity solutions are not mutually exclusive and can be used simultaneously as appropriate for the proposed applications. These different connectivity approaches are likely to co-exist in the future because of the OEMs' desire to differentiate between the costs for services that they have direct influence on (e.g., remote diagnostics and maintenance) and the costs for large bandwidth and frequent-use services (e.g., music streaming).

In an **embedded** system, a complete communication module, which consists of a modem and a Subscriber Identity Module (SIM), is permanently integrated into the car. The application runs on the built-in system and does not require the use of a smartphone. Currently, this solution focuses on vehicle-centric, high-reliability and high-availability applications such as the eCall.

A main characteristic of the **tethered** solution is that it relies on the intelligence of the applications running in the vehicle, while an external SIM is used to enable connectivity. There are basically two ways to enable tethering. Either the vehicle features a built-in modem (with a SIM card slot) or an external modem on a user's mobile device is used, e.g. a smartphone. Usually embedded modems have a more reliable and faster data transfer rate, because of the use of the car antenna. This approach is often used for infotainment services, as it enables the customer to directly manage and pay the costs of services used. For safety and security solutions it remains an unreliable solution, given the need for the user to insert their SIM or activate their phone. The main benefits of tethered solutions with external modems are that they require less costly in-vehicle hardware and external modems are more likely to be up-to-date, given the higher replacement rate of mobile devices.

For the **integrated** approach, the connection is made through a mobile device, but all applications and programs also run on the user's mobile device. The car hardware is solely used for displaying and HMI reasons. The smartphone integration approach is particularly appropriate for user-based services in the field of infotainment and traffic efficiency, because there is a direct allocation of service costs to the end user. Integrated connectivity solutions are likely to remain up-to-date as they rely on mobile technologies with a shorter lifecycle than cars. However, it can be a risky solution with respect to driver distraction and it is also not a reliable approach for safety and security solutions, given the need for users to activate their phone.

The following table contains an overview comparison of the different connectivity solutions.

Connectivity Type	Embedded	Tethered – embedded Modem	Tethered – external Modem	Integrated
Modem	Built-in	Built-in	Brought-in	Brought-in
SIM	Built-in	Brought-in	Brought-in	Brought-in
Intelligence/Applications	Built-in	Embedded	Embedded	Brought-in
User Interface	Vehicle HMI	Vehicle HMI	Vehicle HMI	Vehicle/Phone HMI

[5] GSMA "Connecting Cars: The Technology Roadmap", February 2013

Looking at the current connected car offerings of the different OEMs, one can see that many carmakers take a hybrid connectivity approach. Many car manufacturers launched smartphone integration solutions during the last couple of years, in order to provide the driver with access to internet radio, music streaming and social networking. This trend is likely to continue due to the computing power and personalization capabilities of a user's smartphone. In parallel, many OEMs are trying to keep intelligence and applications in the car, as this is beneficial for offering various services. However, the management of data costs can be a significant barrier to using an embedded SIM for features with unpredictable data consumption (e.g. music streaming). Thus, the described solutions are used in a complementary way in the same vehicle. The key characteristics of the different connectivity solutions are analyzed in the following table.

Type	Embedded	Tethered – embedded modem	Tethered – external modem	Integrated
Data Connection	SIM and modem built into the vehicle – robust and reliable user experience	Modem is built into the vehicle but access to an external SIM is needed – robust communication using vehicle antenna	Mobile device is needed for connectivity (Modem and SIM) – antenna performance likely to be worse than embedded solutions	
Cost structure	Customer pays fees to OEM - costs cannot be differentiated	Ongoing communications charges directly tied to end-user's SIM – no operator negotiations for roaming and billing		
Up-to-date	Limited technology evolution possible, without physical intervention		Easier to keep up with network technology evolution	
Intelligence	Applications run in-car			Applications run on mobile device
Typical Applications	Safety and Security, Remote Services, Cost Efficiency, Traffic Efficiency, Convenience	Remote Services, Infotainment, Traffic Efficiency, Convenience	Infotainment, Traffic Efficiency	

5. OEM's Connected Car Offerings

This report features insights on the connected car offerings of eleven different car brands. The selected OEMs are divided into two categories: "Premium" and "Commercial". The selection represents advanced players and early adopters in the European Connected Car market. Established brands and newcomers are both taken to account. The focus was put on variety and progress of sophisticated connected service offerings instead of market share and revenue figures.

The selected OEMs are:

Premium OEMs:

Audi, BMW, Mercedes-Benz, Tesla

Commercial OEMs:

Ford, Nissan, Opel, Peugeot, Renault, Toyota, Volkswagen

The following subchapters contain information and a brief characterization of the different connected car systems offered by the selected OEMs.

Audi

The "Audi connect" system from Audi uses a tethered solution with an integrated modem to operate a range of embedded applications. The user can either use a separate SIM card which is inserted into a slot in the glove compartment or a remote SIM-Access-Profile featuring smartphone. The system is operated through a central control dial with a touch pad. In order to reduce driver distraction, the system does not have a touchscreen. For its navigation service Audi uses "Google Maps" and "Google Street View". The "myAudi" platform acts as mobile control panel, in which services, such as music and points of interest, can be personalized. A broad range of infotainment applications is offered. The data consumption costs are paid to the customer's mobile network operator (MNO). Audi does not charge monthly fees.

BMW
The BMW “Connected Drive” package offers connected services which are operated on a fully embedded system with a permanently built-in SIM card. It was introduced in 1997. Back then, the key function was an intelligent emergency call which was automatically activated in the event of an accident. Currently, BMW offers a wide range of services including a 24/7 call center, smartphone-controlled remote control functions and automatic maintenance services. The BMW system is controlled by a rotatable dial knob in combination with surrounding softkeys and a touchpad instead of a touchscreen. The user can choose from a number of services, which are enabled for a monthly fee paid to BMW.

Mercedes-Benz
Mercedes-Benz launched the “Mercedes Me” brand in 2014, which is the umbrella brand for a broad variety of current and future services. Most connected car services are offered as part of the “Connect Me” and “Assist Me” sub-brands, but also other service areas, such as car sharing, insurance or financing for example are provided by means of other sub-brands. The connected car system from Mercedes features an embedded communication module with integrated SIM. The “COM-Module” communicates with the “Daimler Vehicle Backend” via a safe VPN-connection. All data transfer between backend and, for example, the traffic server or content provider occurs anonymously. The system is operated through a touchpad which recognizes multi-fingered input gestures.

Tesla Motors
Tesla’s Model S, introduced in 2012, has become a byword in the industry not only for eco-friendliness but also for full connectivity. Most connected services can be executed without the need of a smartphone via an embedded communication module. Tesla offers a wide range of connected services and periodically receives over-the-air software updates that add new features.

Ford Motor Inc.
With its “Sync” system Ford follows a smartphone-centric connected car approach. Ford offers tethered services with an external modem as well as smartphone integration. In order to establish an internet connection, users have to connect their smartphones either via Bluetooth or by using an USB modem. According to Ford’s philosophy, in this way the much longer product lifecycle of a car compared to a smartphone does not have a negative effect on the user experience. The connected applications for the Ford “Sync” system run on the user’s smartphone and are controlled via a head unit and steering wheel buttons or voice control.

Nissan
Nissan uses a tethered connectivity solution without an internal modem. The system connects to the user’s smartphone via the Nissan Connect app, delivering features and services that can be personalized to the driver and focus on infotainment applications. The vehicle comes with a 2-year complimentary subscription. After this period, the owner has the choice of extending the subscription.

Opel / General Motors
By 2015 all Opel vehicles will be delivered with the General Motors “Onstar” system, which has been operational in the United States for over ten years and used by some 6.5 million customers. The system is fully embedded and paid monthly, and the user can choose between different data packages depending on consumption. It features a broad range of services and applications such as an on-board Wi-Fi-Hotspot, remote services and stolen vehicle and roadside assistance, in addition to infotainment applications such as music streaming.

PSA Peugeot Citröen
Peugeot offers an unlimited-charge free telematics service for emergency calls, roadside assistance and navigation. It is currently used in ten middle European countries. The system is available either tethered without modem or fully embedded featuring the so-called “Peugeot ConnectBox”. Peugeot Connect currently features only a small infotainment offering.

Renault
Renault developed the “R-Link” system in cooperation with TomTom and Google Android. The user operates the system through a touchscreen. A SIM card is integrated into the system, which makes it fully embedded. The offered services focus on the field of connected infotainment, but also remote diagnostics are featured.

Toyota
“Touch & Go” is Toyota’s connected car solution offering services by means of a tethered connectivity that uses a smartphone’s modem for the internet connection. The system features a smart emergency call, various traffic efficiency applications, music streaming, “Google Local Search” and social media integration.

Volkswagen
The “Car Net” system can be used with a separate SIM card or with a Bluetooth enabled smartphone with remote SIM-Access-Profile. Therefore, it is a tethered system with integrated modem. The main control and display unit is the touchscreen. Volkswagen offers a large amount of connected services, which are organized into four clusters: “Guide & Inform”, “e-Remote”, “Security & Service” and “App Connect”.

5.1. Connectivity Architecture Comparison

The following table provides information about the selected OEM’s connectivity architectures in order to provide a strategic overview.

OEM	Currently Offered Connection Architecture			
	Embedded	Tethered – embedded Modem	Tethered – external Modem	Integrated
Audi		•		•
BMW	•		•	•
Mercedes-Benz	•		•	•
Tesla	•			•
Ford			•	•
Nissan			•	•
Opel/GM	•			•
Peugeot	•		•	•
Renault	•			•
Toyota			•	•
Volkswagen		•		•

5.2. Connected Services Overview

The following table contains information about the connected services offered by the selected OEMs and serves as basis for evaluating and comparing these services. The table is divided into the five service categories described above. For each category a number of reference services were selected.

Detailed information on the service offerings of each car manufacturer can be found in the appendix. All current car models were analysed.

		Audi	BMW	Mercedes	Tesla	Ford	Nissan	Opel/ GM	Peugeot	Renault	Toyota	VW
Traffic Safety	Remote Diagnostics	◑	●	●	●	◑	○	●	●	●	○	◑
	Stolen Vehicle Assistance	○	◑	◑	●	○	○	●	○	○	○	◑
	Geofencing/Speed Monitoring	○	◑	●	●	◑	○	●	●	○	○	●
	Smart SOS	◑	●	●	◑	●	◑	●	●	◑	●	◑
	Roadside Assistance	◑	●	●	●	○	○	●	●	●	○	●
Connected Infotainment	Internet Browser	○	●	●	●	○	○	○	○	○	○	○
	Wi-Fi Hotspot	●	●	●	◑	○	○	●	◑	○	○	◑
	News Feed	●	●	●	●	◑	●	○	○	●	○	●
	Music Stream	●	●	●	●	●	●	●	●	○	●	●
	Email	●	●	◑	●	○	●	○	●	●	●	○
	Social Media	●	●	●	●	○	●	◑	●	●	●	○
	App-Store	○	●	◑	●	●	●	●	●	●	○	●
Traffic Efficiency	Street View (Google)	●	○	○	●	○	○	○	○	○	●	●
	Traffic Info	●	●	●	●	●	●	●	●	●	●	●
	Online Route Planning	●	○	●	●	○	●	●	○	●	●	◑
	Parking Infos	●	●	●	●	◑	○	○	●	●	●	●
Cost Efficiency	Insurance Telematics (UBI)	○	◑	○	○	○	○	◑	○	○	○	◑
	Driver Behavior Monitoring	○	○	●	○	○	●	○	○	●	○	●
	Real-time Fuel Prices	●	●	●	–	○	●	○	●	●	●	●
	Electric Vehicle Charging	○	●	○	●	○	●	●	●	○	○	●
	Predictive Maintenance	◑	●	●	●	◑	○	●	●	◑	○	●
	Eco Tax	○	○	○	○	○	○	○	○	○	○	○
Convenience and Interaction	Call center	○	●	○	○	○	○	●	○	○	○	○
	Remote Services	○	●	●	●	○	○	●	○	○	○	●
	Electronic Toll Collection	○	○	○	○	○	○	○	○	○	○	○
	Personal Online Platform	●	●	●	●	●	●	●	●	●	●	●
	Car sharing	●	●	●	○	●	○	●	●	○	○	●

● Implemented

◑ Planned

○ Not offered

6. Evaluation and Comparison

The evaluation of the offered connected services is divided into a comparison of the premium brands and the commercial sector.

6.1. Premium Car Brands

During the past couple of years BMW had clearly the largest and most sophisticated offering when it comes to connected car services. Although the Bavarian OEM still stands out as the pioneer, the competitors Audi and Mercedes have managed to catch up. Mercedes converted its initially tethered system into an embedded one, whereas Audi still remains with its tethered solution. Tesla's connected services are fully embedded and require the use of a smartphone only for phone calls.

Traffic Safety

When it comes to safety and security services BMW and Mercedes have similar offerings. Audi, however, lags behind at the moment, but announced that it was going to introduce a smart emergency call (eCall) and maintenance telematics feature in 2015, as these services are highly demanded by customers and officially mandated by authorities in Europe. Mercedes will introduce a geo-fencing and speed monitoring application, for parental control. This would put them ahead of the competitors, with respect to traffic safety service offering. Tesla enabled a geo-fencing application via an over-the-air update. The newcomer also offers remote diagnostics and roadside assistance services. Up to now an eCall is not yet implemented.

Connected Infotainment

In the field of connected infotainment, all three premium brands have a large amount of sophisticated applications. Music streaming, real-time news updates, Wi-Fi connection for passengers, e-mail and social media are standard features. Although the "Audi connect" system and "Mercedes Me" offer a large number of additional infotainment applications, such as an event guide and real-time flight information for rides to the airport, it does not feature a separate app store, like BMW's "Connected Drive". An internet browser is offered by BMW, Mercedes and Tesla. Regarding smartphone integration, it is interesting to mention that Audi is the only one of the three to implement Google's "Android Auto" as well as Apple's "CarPlay". BMW and Mercedes currently only plan on providing the Apple system, as an interface add-on. Tesla has not mentioned any plans on implementing "CarPlay" or "Android Auto".

Traffic Efficiency

With respect to navigation and traffic information, all four brands offer extensive and highly developed services. In addition to real-time traffic information, Audi and Tesla have embedded "Google Street View" into their navigation system, so the user can get an idea of the destination before arrival. Mercedes and BMW do not use Google maps for their navigation services. Another interesting navigational feature, which is offered by Audi, Mercedes and Tesla, is the ability of planning a route at home or on a mobile device and sending it to the car, where it then can be used. Especially for longer trips or journeys with multiple destinations, this can be a helpful application. It can also be used for planning recharge stops for electrical vehicles.

Cost Efficiency

Cost-saving applications are at the moment not very widespread among the premium car brands. BMW, for example, is the only OEM to announce a usage-based insurance model integrated into the connected car system. Up to now, insurance companies offered this calculation model by providing separate hardware and analyzing solely the customers' mileage consumption. If this service is implemented by the OEM, it can account for additional hardware inputs and consequently provide more accurate driver behavior information. Another way in which the customer can save money

is by monitoring the technical status of the vehicle, especially its wearing parts, and notifying the user early enough, in order to prevent further damage. These predictive maintenance services are already offered by BMW, Mercedes and Tesla. Audi is planning on introducing them in 2015. This service can also be seen as a convenience application or from a safety standpoint. The lack of service offerings for cost efficiency applications in the premium sector is mainly due to the fact that the demand priorities of this group of customers lie in other fields.

Convenience and Interaction

Vehicle interaction services usually require the car to have an autonomous communication module with an integrated modem, which is the case for all listed premium OEMs. BMW, Mercedes and Tesla have developed a broad range of remote applications. The user can, for example, check vehicle parameters, such as fuel or battery level, activate the cooling or heating system, and monitor the vehicles location via a mobile app. Tesla will take the steps towards autonomous driving by implementing a completely remote parking service. Vehicles shipped by 2016 will be able to park themselves in the owners' garage or into charging stations without a driver sitting behind the wheel. Audi does not offer these remote services, but only offers a mobile platform called "myAudi", which is used for personalization and settings and can be operated from a mobile device or personal computer. It is similar to BMW's customer platform but has less features then the "Mercedes Me" platform, where even financing features are implemented. With "Car2Go" and "DriveNow" Mercedes and BMW launched a large-scale car sharing service in Europe and North America, which relies on connected car technology. Audi follows a more personal concept of car sharing, which is currently tested in a pilot project named "Audi unite". The idea is to offer the possibility of sharing a single Audi by up to five people. Acquisition and regular costs are shared and usage is managed through connected car services. Tesla does not offer car sharing, but an independent platform was launched based on the connected services implemented in the Model S.

6.2. Commercial Car Brands

When comparing the connected car services of the mentioned commercial car brands, one has to admit that Volkswagen at the moment has one of the most advanced and sophisticated offerings. Nevertheless, this could change soon, as Opel is introducing the General Motors "Onstar" system to all its models by 2015. General motors gained a lot of experience with this system, which currently already has over 6.5 million users in the United States. But also, the other listed OEMs offer connected services and are continuously improving them.

Traffic Safety

With respect to traffic safety and security services, the "Onstar" system offered by Opel in Europe and the Volkswagen "Car Net" are clearly the most multifaceted. In addition to the smart emergency call and roadside assistance in case of a breakdown, the user is offered automatic maintenance alerts, geo-fencing and speed monitoring, for parental control, and stolen vehicle assistance, which is implemented through geo-tracking. Therefore, Opel and Volkswagen can easily compete with the premium brand offerings in this category. With the remote diagnostics and roadside assistance service, Peugeot can stand out from other brands, which mostly only offer a smart emergency call.

Connected Infotainment

Opel and Volkswagen are the only brands offering an in-car Wi-Fi hotspot. With this feature, the car infotainment experience can be improved for all passengers using mobile devices. Despite this fact, other car brands, such as Nissan and Renault, have a more extensive application offering. News feed, music stream, email and social media are just a sampling of available applications. Peugeot's offering in this field is still limited, as its only applications in this category is a point of interest search, in cooperation with TripAdvisor, and a weather application.

Traffic Efficiency

With its predictive navigation service, Volkswagen has taken a step ahead of the competitors, with respect to navigational innovations. While all navigation systems from the listed brands provide detailed information on the traffic status on a specified route, the navigation system is not used on many daily drives, either because the routes are familiar or because keying in the destination is time-consuming. The Volkswagen "CarNet" system notes the regularly driven routes and automatically scans them for traffic problems, even when navigation is inactive. Of course, traffic information is not the only data provided by connected car navigation systems. Ford, Peugeot, Renault, Toyota and Volkswagen provide real-time information about parking locations and prices at the desired destination. Another connected car feature for navigation is the possibility of online route planning. Routes can be planned on a mobile device or personal computer and sent to the car, which is especially convenient for multiple destination routes or long distance travelling. This service is offered by Opel, Renault, Toyota and Volkswagen.

Cost Efficiency

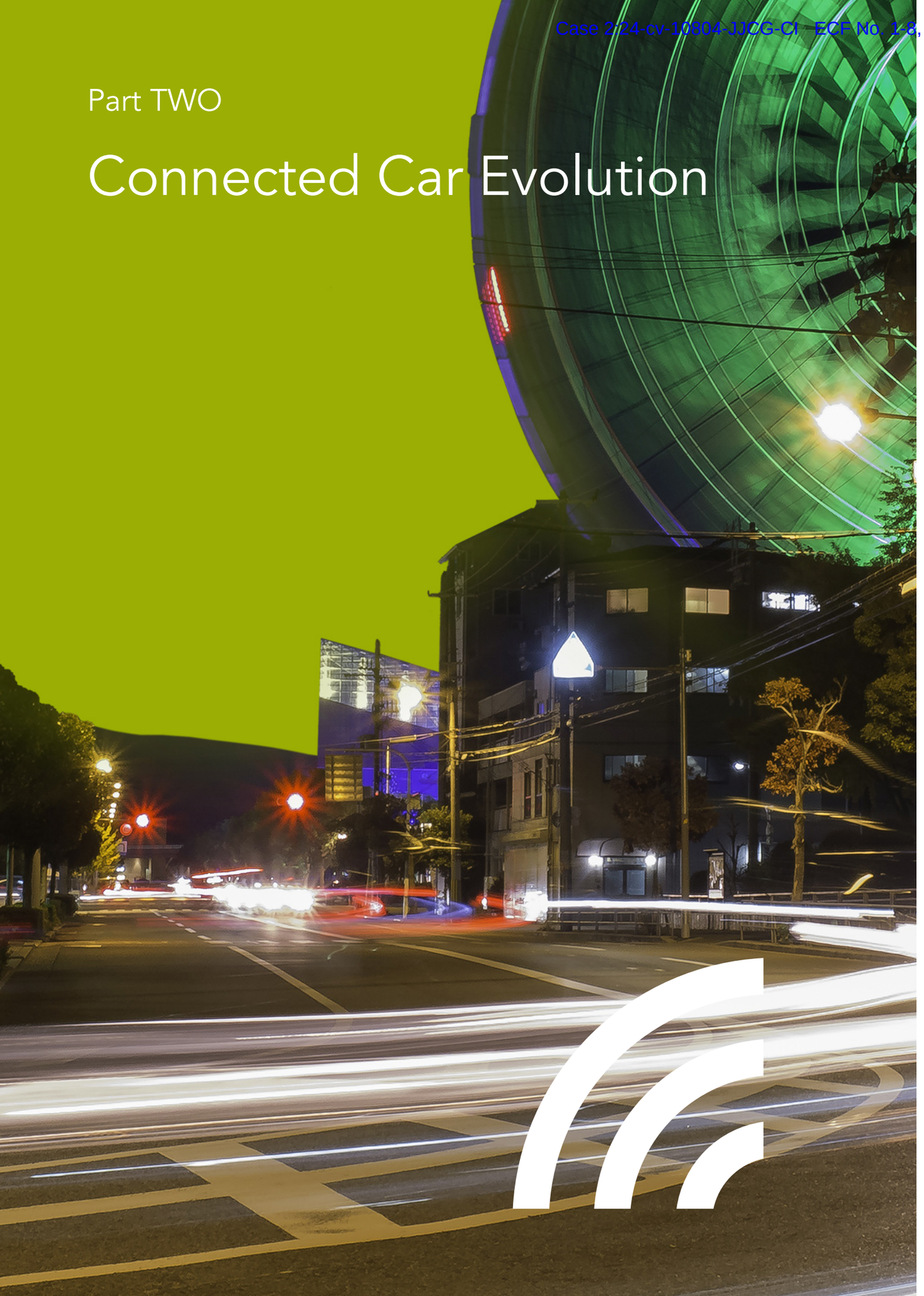
Alongside the initial purchasing price of a car, the owner has costs for insurance and maintenance on a regular basis. With respect to maintenance issues, the specific moment of action has an effect on the costs. If an oil change, for example, is performed too early, it is a waste of resources but if the owner waits too long the engine will suffer and this might result in even higher costs. In order to identify the right moment, OEMs such as Ford, Opel, Peugeot, Renault and Volkswagen offer a predictive maintenance service. Another widely implemented cost efficiency feature is real-time information about fuel prices of surrounding gas stations. This service is offered by all listed OEMs except for Ford. An additional feature regarding energy consumption is a driver behavior monitoring application, which aims on improving the driving habits of a customer towards more efficient use. It is implemented in the systems of Nissan, Peugeot, Renault and Volkswagen.

Convenience and Interaction

As part of the "Onstar" system, Opel is the only commercial brand to offer a 24/7 call center. By pressing the "Service Button" the user has a personal point of contact in order to gather information about the desired destination or request assistance in the event of a breakdown. The other listed brands do not feature a lot of vehicle interaction services except for Volkswagen's "Car Net", which has a broad range of remote applications. These can be used for retrieving vehicle information, controlling the heating and cooling system or locking and unlocking the car. This kind of service requires the car to have a modem-integrated connectivity architecture. For this reason OEMs such as Ford, Toyota and Nissan are not able to offer them without major changes to their systems, whereas Peugeot and Renault have the potential of extending their service portfolio in this field.

Part TWO

Connected Car Evolution



1. Vehicle Data

The basis for all connected car services is information, which is either broadcasted to the vehicle or collected from several built-in sensors and devices. This section gives an overview on the data-generating sources in the car, which can be used for different services. It should be pointed out that this description is not constrained by existing application offerings, but instead aims at giving the understanding of which data could be gathered (now or in the future) and can consequently be used for services of any type.

1.1. Event Data Recorders

Event Data Recorders (EDRs) are used for the aforementioned smart emergency calls, as they record a brief snapshot of information related to an “event” from the vehicle system. These snapshots are usually recorded for a period of several seconds and contain information about pre-crash vehicle dynamics, system status, driver inputs like steering and braking, seatbelt usage, airbag deployment and post-crash data. Unlike black boxes found in airplanes, automotive EDRs do not record audio or video information yet.

1.2. On-Board Diagnostics

On-board diagnostics (OBD) provides users with early dashboard warnings of malfunctions and thus protect not only the environment but also consumers, by identifying minor problems before they become major repairs. At repair shops or car dealers, technicians use scanning tools to display information about the cause of a vehicle’s problem.

1.3. Location Information

In-car location based services have existed through personal GPS devices and navigation apps in smartphones for a long time, but with connected cars, these services are taken to the next level. A vehicle’s position can be determined through a variety of different methods, such as cell tower signal-based technologies, Wi-Fi access points, crowd-sourced positioning and GPS technology.

1.4. External Information

By detecting lane markings and obstacles, onboard sensors and cameras can be used to gather information about the car’s immediate surroundings. These systems rely on ultrasonic, radar and digital imaging technologies. Usually, the information collected by these devices is used for driving assistance programs, such as blind spot detection, rear-parking and lane-departure warnings.

1.5. Biometric Information

The collection of biometric information in cars involves physical data such as facial and voice recognition or vital signs. This can serve as anti-theft protection, as well as provide increased safety and comfort inside the vehicle, by using gesture control or eye tracking to improve the interface experience.

1.6. Behavioral Information

In order to detect driver fatigue, in-car technologies can gather information about speed, steering and braking inputs and in this way increase safety. Also, long-term driving behavior information can be gathered an analyzed, which can be used for adapting a more fuel-efficient driving style. Car manufacturers and safety regulators are also working on in-vehicle systems that could reliably detect when someone is too drunk to drive[6].

1.7. Subscriber & Registration Information

In the traditional car retail concept, OEMs lack a direct relationship to their customers, because of the relationship between automakers and car dealers. Through the evolving connected car services, this will dramatically change as these services require personal information such as the user's name, address and billing information.

1.8. Vehicle-To-X Communication

Dedicated short-range communications (DSRC) is a short-range automotive communications protocol used to facilitate the connectivity between equipped cars. The technology be used for vehicle-to-vehicle communication but also for vehicle-to-infrastructure communication. Whenever a connected car comes into range with smart infrastructure or another equipped vehicle, they will be able to create a network in order to exchange information regarding position, speed and direction. In this way, hazards can be sensed and drivers warned early enough to avoid crashes. In addition, this technology allows vehicles to cooperate with each other to ease traffic flow.

1.9. Infotainment Usage

The usage history of various in-car infotainment applications is a reliable source for customer preferences and affections. Music streaming, point of interest search and other applications can be taken to account.

[6] http://www.wsj.com/articles/SB10001424127887324352004578131083891595840

2. Key resources

In order to establish a value proposition and serve a market, a number of resources are needed. These can be divided into four categories: physical, intellectual, human and financial. One of the most important resources when it comes to connected car services is IT/TC servers and systems, which enable the application and processing of data. In contrast to conventional cars, a connected car usually requires additional consumer electronics hardware such as communication modules, displays and control units. With respect to intellectual resources, intensive skills in programming, software development and telecommunication engineering is necessary. As these are not the traditional strengths of a car manufacturer, they require special effort and collaborations. Many OEMs have established strong partnerships with content providers from various fields (digital roadmap, traffic information etc.) and MNOs for connectivity reasons.

> *We believe that it is critical to look beyond our own industry as we seek to create the most compelling experiences for our customers.*
>
> Ola Källenius, Marketing & Sales Mercedes-Benz Cars

Partners and providers of OEMs with respect to connected cars can be divided into five blocks:

Software Platform	• Operating System • Auto-specific middleware • Auto-specific HMI software
Hardware	• Displays/Touchscreens • Control Units • Speakers
Apps & Services	• Map Providers • Social Networks • Traffic Info Providers • Music Streaming
Sales & Distribution	• Retailers • App Store Operators
Connectivity	• Mobile Network Operators
Development Alliances	• Car2Car Communication Consortium • Standards and Norms • Political Institutions

As cars turn electronic, these partners become even more important for OEMs to be successful than they had already been in the past. The crucial elements of connected car development — software, electronics and automation — are not among the traditional OEM specialties such as vehicle assembly, design and marketing.

3. The Role of third-party Service Providers

By looking at the variety of connected car services, one can easily see the complexity of developing and operating them. A great number of services include third-party content and therefore require a close cooperation between OEMs and service providers. The collaboration of car manufacturers and third-party content providers and developers can be divided into two groups.

Front end services

- connectivity infrastructure
- app development
- standardization issues
- providing assistance for connectivity issues
- dealing with country-specific differences (MNO contracts, etc.)
- new sales and distribution methods
- developing and executing car sharing business models

Back end services

- Big Data analysis
- raising awareness for connected car advantages to overcome customer doubts
- data privacy issues

4. Application Development

Connected car applications are only useful if they are carried out in an easy-to-handle, customer-tailored and safe environment. This means offering a wide range of innovative user applications, which can be operated with minimal driver distraction and thus enhance the driving experience. In order to reach this highly challenging goal, OEMs have established different strategies.

In general, there are four different ways to operate applications in vehicles. They can be developed either on the head unit or via a smartphone link. It is further possible to access vehicle data and interact with the car via remote API or using a Bluetooth OBD-II (On-board Diagnostics Port) dongle. The four integration modes are listed in the following table, including examples from the industry.

Embedded Apps	Smartphone Link	Remote API	Bluetooth Dongle
Apps run on the in-car infotainment system	Apps run on mobile device but are controled and displayed by car hardware	Access vehicle data and remotely control the car	Use OBD-II to access vehicle data
QNX, Windows Embedded Compact, Android, GENIVI	MirrorLink, APPLINK, Android, Apple	Ford, GM, Airbiquity	dash, Carvoyant, MOJIO

4.1. Embedded Applications

Head Unit Applications for car infotainment systems are either built in-house by OEMs or more commonly outsourced to tier-1 suppliers. The leading supplier of infotainment platforms with a deployment in over 50 million vehicles and a market share of over 50% is BlackBerry's QNX CAR platform. It is followed by Microsoft's Windows Embedded Automotive, which is used, for example, in Ford's SYNC system. Market challengers are Linux with the open-source Genivi platform and Google's Android, which acts as basis for Renault's R-Link system. The established platforms are used by OEMs primarily to reduce software development costs.

4.2. Smartphone Link

Due to the immense growth of smartphone usage in the recent years, many connected car services shifted to integrating cars with smartphones. Similar to the embedded application approach, the idea is to provide safe, valuable and real-time infotainment in the car. Applications designed following the smartphone link concept run primarily on a smartphone instead of the car infotainment system and interact with the car through a strictly defined API. The car thus becomes a smartphone accessory, similar to devices such as smart watches or activity trackers. The basic idea behind this concept is that innovation is much faster on the phone than it could be on the head unit. The integration between car and smartphone includes various interface aspects such as steering wheel controls, head unit buttons, built-in voice recognition, smartphone voice recognition and in-car displays.

By 2014 four major initiatives have emerged which all share the goal of becoming the standard for smartphone integration in cars. The Car Connectivity Consortium (CCC) has established an open industry standard for in-car smartphone integration called **MirrorLink™**. The CCC is an alliance of OEMs with consumer electronics companies and other related companies. Among the carmakers, Ford, who open-sourced its **AppLink** system, can be seen as a major innovator with respect to the smartphone link approach. But the two major smartphone platforms are striving for their share. Apple launched **CarPlay** in cooperation with OEMs and aftermarket systems in late 2014. Google will soon follow with its **Android Auto** system, which was developed as part of the Open Auto Alliance (OAA) announced in January 2014. The user interfaces of these systems will be similar to their corresponding smartphone interface. The main difference lies in fact that Apple follows a more restrictive development approach than Google, which is a well-known fact from the field of smartphone applications. Although "HMI" projection solutions are not new to the automotive industry, the brand image and market presence that Apple and Google carry are expected to cause some disruption.

All mentioned initiatives have signed partnerships with major OEMs. The following table contains information about the car manufacturers selected for this report and is not exhaustive.

OEM	MirrorLink™	AppLink	CarPlay	Android Auto
Audi			•	•
BMW	•		•	
Mercedes	•		•	
Tesla				
Ford	•	•	•	•
Nissan			•	•
Opel/GM	•		•	•
Peugeot	•		•	
Renault	•		•	•
Toyota	•		•	
Volkswagen	•		•	•

4.3. Remote API

Vehicle APIs can be used to actively control the car, remotely enabling the presented connected car services. Traditionally, OEMs do not open the car APIs to external developers, but instead run limited experiments in closed partnerships or in hackathons. This is about to change. Recently General Motors has offered a set of APIs on its developer portal. Ford added remote APIs in version 2.0 of its Applink suite. This strategy opens up a big potential for third-party developers.

4.4. On-Board Diagnostics Port

The On-Board Diagnostics Port (OBD-II) has been mandatory in vehicles since over a decade. It allows external developers and startups to take matters into their own hands by providing them access to vehicle data. The range of possible applications is wide, as there are currently close to 200 apps using the OBD-II port technology in the Google Play store. With this approach, the application typically runs entirely on a mobile device, in the cloud or on a computer, instead of on the car's infotainment system. In general, OBD-II ports cannot be used to control the car and therefore limit the scope of action for external developers.

Startup companies such as Dash Labs, Mojio, and Carvoyant use Bluetooth-enabled dongles connected to the OBD-II port to transform a normal car into a connected one, by making vehicle data available on smartphones and for developers.

4.5. OEM Development Platforms

In order to foster innovation and variety, many OEMs have established their own development environments for external developers. The finalized products are reviewed and consequently offered to the customer via app stores. This open development approach occurs in addition to in-house and outsourced software development and has proven extensively successful in the field of smartphone applications.

In 2010, the BMW Group introduced their application-based smartphone integration into vehicles. In order to ensure high-level integration of third-party applications, a special Software Development Kit (SDK) is offered, including guidelines and specific tools to support third-party providers. The head unit app is able to use the audio system and process vehicle data. Following an approval process, the applications are certified and made available through BMW staff via an embedded app store.

In addition, Ford has launched an open development program that lets third-party software developers interface directly with Ford vehicles. Unlike BMW's head unit approach, Ford follows the smartphone link philosophy, where the apps run on a smartphone. In this case, the built-in infotainment system becomes a second display for smartphone apps.

Other OEMs such as General Motors, Peugeot and Toyota are also planning on fostering the development of new applications through an open development approach. Toyota announced a cooperation with IBM for establishing their development platform called "T-Connect" for onboard devices and interactive applications.

4.6. Proprietary Solutions

Some OEMs do most of their development in-house, which creates the flexibility and speed dictated by the short development cycles and various platforms, but comes at the cost of higher expenses and a possible lack of innovation. As a fully-owned subsidiary of Audi AG, Audi Electronics Venture GmbH (AEV), for example, is responsible for implementing innovations in the vehicle based on new technologies. As part of this objective, AEV covers the entire spread of development activities of vehicle-related mobile applications, from concept to implementation. Third-party developers are not offered the possibility of implementing their apps into the "Audi Connect" system.

Other OEMs prefer proprietary solutions licensed from suppliers. Nissan, for example, uses software by Airbiquity, a global player in connected car innovation with an own cloud-based car connectivity platform.

4.7. Summary

The various vehicle-related mobile app development and integration strategies presented in this section can also be executed simultaneously. Some OEMs such as BMW operate their own development platform, while also being part of the CCC's MirrorLinkTM program. Due to the high degree of complexity, variety, compatibility issues and the early development stage of connected cars in general, it is highly recommended that OEMs incorporate the competences and resources of external developers and expert partners. The following table contains a comparison of the selected OEMs with respect to their in-car application development strategy for separate app stores.

OEM	In-House	Open Development Platform	Partnership
Audi	•		
BMW		•	
Mercedes	•		
Tesla	•		
Ford		•	
Nissan			•
Opel/GM		•	
Peugeot		•	
Renault			•
Toyota		•	
Volkswagen	•		

5. Technical Challenges

Despite the high demand for connected car solutions and the large growth potential, there are a number of challenges which the OEMs and third-party providers have to meet in order to be successful in this young market.

5.1. Use of Standards

As a connected network usually involves a large number of different participants, the compatibility of interconnectivity must be assured between all subscribers. To ensure the fulfillment of this goal, market players and authorities have made efforts for developing standards, procedures and norms.

W3C

In February 2015, the "World Wide Web Consortium" announced a new automotive industry collaboration initiative. The effort will focus initially on giving application vendors standard and more secure access to vehicle data[7]. Numerous automotive industry leaders participated in the Automotive and Web Platform Business Group that created the draft specifications: BSQUARE, BlackBerry, Continental, Ford, General Motors, GENIVI Alliance, German Research Center for Artificial Intelligence (KI) Gmbh, Harman, iHeartMedia, Intel, JEITA, Jaguar Land Rover, Japan Automobile Research Institute, KDDI, LG Electronics, Mitsubishi, Neusoft, Nokia, OpenCar, Orange, Pandora Media, Porsche, Samsung, Telenor, TotalFinaElf, Verisign, Visteon, Vodafone, and Volkswagen.

European Commission – Connected Car Standards

Two European standards organizations, ETSI and CEN, completed the basic set of standards requested by the European Commission. The standard[8] ensures that vehicles made by different manufacturers can communicate with each other.

IEEE 1609 – Family of standards for Wireless Access in Vehicular Environments (WAVE)

Provision of externally-driven services to vehicles has been limited because of the lack of ubiquitous high-speed communications between vehicles and service providers, and the lack of homogenous communications interfaces between different automotive manufacturers. The IEEE 1609 Family of Standards for Wireless Access in Vehicular Environments (WAVE) completely address the latter issue, and provides a sufficient foundation regarding the organization of management functions and modes of operation of system devices to address the former[9].

5.2. Customer Relationship

The biggest commercial opportunity we have around Big Data right now is in marketing.

Andy Palmer, CPO Nissan Motor Co.

The rise of the connected car will require significant changes in the traditional business model of many OEMs. Up to now, the only contact with the customer was through mass-market advertising. During the past few years, this relationship has been enriched through social media activities and will unquestionably evolve with the increase of connected car usage. The car itself has the potential to serve as a CRM platform, not only enabling direct marketing of new services and apps, but also increasing brand loyalty.

[7] http://www.w3.org/2015/02/auto.html.en
[8] http://europa.eu/rapid/press-release_IP-14-141_en.htm
[9] http://www.standards.its.dot.gov/factsheets/factsheet/80

5.3. Product Lifecycle

Compared to most devices from the field of consumer electronics, a car has a much longer lifecycle. While the average lifespan of a notebook is around 29 months[10], a car is on average scraped after 18 years[11] In order to allow the customer to keep up with the technological evolution, software and hardware updates play an important role in the field of connected cars. Audi, for example, introduced its modular infotainment platform (MIB) in cooperation with NVIDA in 2012. The recently presented second-generation MIB-2 electronics architecture dramatically shortens the timeline to introduce newer and more powerful processors used for infotainment and driver assistance systems.

With about a 100 million lines of code, a modern upper-class limousine has a higher amount of implemented software than a state-of-the-art jetliner. Considering this fact, it is easy to understand the importance of software updates. These software updates encompass every vehicle system — from infotainment, safety, comfort and powertrain — and are traditionally done at the dealership or repair shops. The connected car allows for a more convenient, faster and cost-effective way of "over-the--air" (OTA) updates. This not only saves the customers the frustration of a dealer visit, but will also cut across the industry. In order to show how powerful OTA updates already are, one has only to take a look at Tesla's "Model S". The all-electric car manufacturer's OTA update bumped up the 0-60 mph speed by one-tenth of a second only by upgrading the inverter algorithm, which changes direct current electricity to alternating current. There are also unconfirmed reports about increasing the chassis clearance of the entire fleet by ten millimeters via OTA update after swirled up debris caused a battery fire.

It is no longer acceptable to innovate at the pace of automotive.

Derek Kuhn, Sales and Marketing QNX Software Systems

Many automakers are starting to enable some of their vehicles to receive OTA software updates, but those are limited to either navigation mapping systems or entertainment units. OEMs cite customer satisfaction as the major driver behind this technology. BMW, for example, has announced an LTE-telematics architecture that will enable navigation system map updates. In general, OEMs are very careful about extending these features, because if a hacker is able to access a vehicle's powertrain or braking system, this would result in a serious safety vulnerability. Marcus Keith, project leader of Audi Connect, states that Audi will implement OTA updates only for infotainment content for the next couple of years and that a major modification to the hardware architecture would be necessary if OTA updates are to be extended[12]. The reason for that lies in the vehicle's internal bus, which is in most cases a CAN (controller area network). This standard with hard firewalls creates ECU (electronic control unit) islands, which means that you can wirelessly communicate with the infotainment system ECU, but not the ECUs controlling airbags, antilock braking, cruise control and electric power steering. Even more modern transport specifications, such as Media Oriented Systems Transport (MOST), contain a number of various protocols, depending on the deploying OEM.

In general, software and hardware updates play an important role throughout the connected car lifecycle, and customers demand the safest and most convenient way of performing these updates. This combination of safety and security issues with a convenient user experience is a big challenge for OEMs.

[10] http://de.statista.com/statistik/daten/studie/182759/umfrage/durchschnittliche-lebensdauer-von-normalen-und--robusten-notebooks/
[11] http://de.statista.com/statistik/daten/studie/316498/umfrage/lebensdauer-von-autos-deutschland/
[12] CarIT Magazine 01/2015, Page 28

5.4. Connectivity Infrastructure

One of the technical challenges the industry has to face is the fact that some of the major areas that cars are used in lack cellular coverage. Motorways and country roads in rural areas are arguably some of the areas where connected car services will be widely used. Therefore, network operators need to extend coverage in these areas for connected car services to evolve. When looking at the rapid growth of the connected car market at this stage, there can be little doubt that the return on investment will make it viable for network operators.

5.5. Data Security and Privacy

The connected car is by its very nature highly traceable. Many services require the use of location data. Because of this, data security and privacy is an important topic and the top priority for OEMs in order to attract the customers' trust.

At the end of 2014 the German ADAC alerted BMW because of a major security leak in their remote services. The investigators realized that the car lock could easily be opened by hacking themselves into the car operating system, only using standard equipment[13]. The bug was removed, without any foul play reported. The question of whether it would have been easier to unlock the car with this type of hack or by conventional burglary methods remains.

The data that we collect is our data and not Google's data. When it gets close to our operating system, it's hands off.

Rupert Stadler, CEO Audi AG

Probably the biggest security issue with respect to connected cars was made public in February 2015. According to leaked intelligence documents, the British intelligence agency GCHQ and the American NSA managed to hack into the production system of the world's largest SIM card producer, "Gemalto", which reportedly ships some 2 billion SIM cards a year all over the world[14]. It is assumed that these agencies consequently gained access to all transferred data on these SIM cards, which should have been protected by means of SIM encryption, as part of the SS7 protocol. This major incident is especially interesting, when comparing the European and US IoE communication strategies in general. In the US model, the telecommunication companies play the role of access providers, whereas IT enterprises are responsible for safety issues, by means of TCP/IP protocols. With this kind of end-to-end encryption, the data is encrypted and tunneled through the telecom data centers. However, in the European strategy, the encryption responsible instance is designated for the telecommunication companies. This is due to a lack of competitive European IT companies. Authorities are thus trying to keep control of their data. But the "Gemalto" hacking incident puts this strategy into question.

In the field of data security and privacy issues, OEMs are well-advised to closely cooperate with expert partners from the IT sector. Software vulnerability can easily lead to serious problems and further consequences to a loss of trust among customers.

[13] http://www.faz.net/aktuell/wirtschaft/neue-mobilitaet/adac-findet-sicherheitsluecke-bei-bmw-connected-drive-13399314.html

[14] blogs.wsj.com/briefly/2015/02/20/5-questions-about-the-gemalto-hack/

5.6. Big Data

Different connected car services, such as maintenance telematics, require the analysis of a large amount of generated data. The vice president of after-sales service technologies for the BMW Group, Axel Deicke, speaks of a total increase of technical data received from 20 GB in the entire year of 2011 to daily 30 GB by now[15]. These concrete numbers do not include data from market research and customer support. This dramatic increase is mainly due to the large number of electronic components, which monitor usage, deterioration and defect of various parts. All this generated information would be worthless without the ability of analyzing the data. But repair management is by far not the only application field for big data analysis techniques. When it comes to optimizing supply chain management, connected car technologies can help meet customer demand for specific car models and replacement parts. On the basis of the collected data, forecasts of market changes and fluctuations can be improved and consequently processes can be controlled more accurately. With respect to big data applications, there are also possibilities in the field of marketing, by measuring the success of campaigns and customer promotions, and in management, by supporting strategic decisions.

OEMs inevitably have to deal with big data issues when it comes to connected cars, in order to be competitive. Many OEMs have established partnerships with third-party providers to meet these challenges.

5.7. Vehicle Data Access

A key factor for most third-party activities in the field of connected cars is access to information. Especially for app development and Big Data analysis, external providers are relying on in-car generated data. Basically, all OEMs which operate an open development platform are granting access to vehicle data. BMW and Ford are granting external developers access to a huge amount of vehicle-specific data for app development. Aside from specific information regarding location and internal system, the open community can develop applications on the basis of real-time data regarding external parameters, for example rain intensity, and driving parameters such as lane departure and parking distance. General Motors, Toyota and the members of the Car Connectivity Consortium have announced a similar strategy. Even though Toyota does not specifically talk about which data is shared with external developers, they say that vehicle data access is provided in order to enable innovative application development.

OEM	On-Board Diagnostics	Event Data	Geolocation Information	External Information	Driver Behavior	Subscriber Information	Vehicle-to-X Communication
BMW	•	•	•	•	•	•	•
CCC*	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Ford	•	•	•	•	•	•	•
Opel/GM	•	•	•	•	•	•	•
Toyota	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

* Car Connectivity Consortium: BMW, Fiat, Subaru, General Motors, Honda, Hyundai, Mazda, Mercedes-Benz, PSA Peugeot Citroën, Renault, Toyota, Volkswagen, Volvo

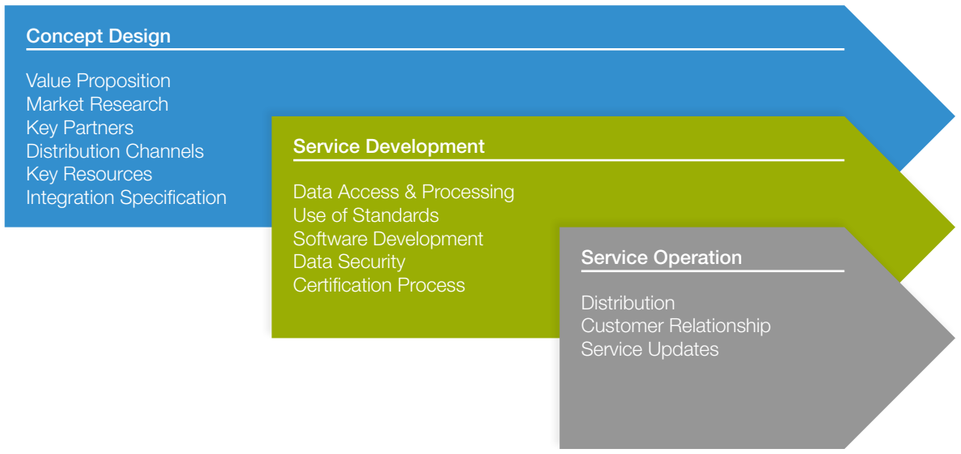
The fact of cooperating with third-party providers and developers will most certainly lead to faster growth and more diverse application offering, but ultimately it comes down to the cost of sharing important vehicle data. At the end of the day, customer satisfaction will yield its fruits. The OEMs listed here are pioneering in this role and others are expected to follow.

[15] www.computerwoche.de/a/datenberge-auf-vier-raedern,2521941

6. Case Study: Car App

The following chapter describes the development of a connected car service as a case example to discuss opportunities and challenges for a service provider when operating in the connected car field. The service which is presented in this context aims to provide information based on objective car indicators. The case study is discussed by using the following scheme, and emphasizes the development process rather than business aspects.

In general, the development process is executed in three stages. Initially, the developer must be aware of the value proposition of planned service application and should also conduct demand analysis. In this early stage, it is also important to already think about possible partnerships, distribution channels and needed resources. Stage one is completed by making a decision on which of the four integration modes, presented earlier, is most suitable. The development phase usually involves close interaction with the OEMs, in order to access vehicle data or overcome compatibility issues. The data security strategy is also defined and implemented at this stage. Depending on the type of service and development platform, a certification process might be necessary, which is conducted by an OEM. After reaching the certification status, stage two is completed and the service distribution can begin. During the third stage, it is important to keep in touch with customers and their needs, by offering service updates and add-ons.



6.1. Concept Design

Value Proposition

The data that can be gathered from a car can add relevant information to current existing business models. This information can help many businesses enriching their customers' database with relevant information that can help them minimize risks (e.g., insurance companies). They will therefore be able to reduce costs and/or improve their value proposition to customers.

This may lead to Connected Car solutions that gather a huge amount of data. Using this information in an objective way to determine more precisely the value of a specific service will have benefits for both customers and enterprises.

Market Research

Using car data will add additional parameters to the value determination process of a service, so the market value of the service can be better defined and compared.

Integration Specification

Connected Car services can be integrated into the car in two different ways. For long-term screening applications, an embedded solution is definitely prioritized. Extra hardware and/or the need for a smartphone can cause connectivity problems and consequently lead to an inaccurate analysis. For these services, it is only reasonable, if the data analysis algorithm is activated from the first to the last day of the car usage period (or a high percentage of usage). The user must agree with the fact that a considerable amount of private data is processed and evaluated at any time the vehicle is used. The relevant data could be stored using a cloud solution and the output could be displayed via an in-car or mobile app, which would result in a convenient user experience with minimal necessary interaction.

Key Partners

Depending on the service possibilities, companies will require other partners in order to find the service solution. In fact, the success of many services will depend on partnerships, such as e-commerce partners, their own service providers, etc.; i.e. for services offering the payment through the connected car platform.

Distribution Channels

Most of the applications should be operated throughout the entire lifecycle of vehicles, so a distribution channel which strongly involves OEMs could be targeted.

Key Resources

For solutions requiring a large amount of data, this information should be stored using the proper big data infrastructure and cloud-based solutions. A server and connectivity infrastructure is therefore needed. With respect to human resources, there is a need for specialists from the fields of big data, analytics and vehicle mechanics. In addition, data security experts should be consulted to ensure a safe operating environment.

6.2. Service Development

Data Access and Processing

In order to evaluate data, it is important to engage analytics professionals and/or business partners — as well as business process experts — in the solution development. Their goal is to analyze the impact of the data generated in the car on the solution business process. This data could, for example, be taken from:

- Mileage counter
- Accelerometers
- Airbag sensors
- Speedometer
- Parking sensors
- Maintenance information and intervals

Use of Standards

The use of standards could play an important role if the service is to be offered for various OEMs. The efforts of the aforementioned W3C platform will be especially beneficial for developing applications that rely on access to vehicle data. Due to the early stage of this project and the lack of comprehensive vehicle-data and access standards for all OEMs, for the moment the best strategy is to establish a strong collaboration arrangement with specific OEMs and think of a generally compatible version further along.

Software Development

For a reliable vehicle data software developers have to collaborate closely with analytics and business experts (e.g., car engineers and mechanics) in order to pinpoint certain data value factors

during a vehicle lifetime. With respect to the huge amount of instruments and sensors which are integrated in a modern car, it is highly recommended to consider expert advice. In this context, a considerable amount of work has already been done through services like maintenance telematics, event data recorders, etc., which are offered by various OEMs. The primary task is to collect and filter this data. As mentioned earlier, for vehicle applications that consume a large amount of data, it is best to be embedded in the vehicle's operating system.

Data Security

As many services involve private data such as location and behavioral information, privacy protection is an inevitable part of the development process.

Certification Process

Before the application is enabled in the OEM's distribution channel, it has to be approved and certified. This process can differ significantly from company to company, which has to be taken to account in the planning process.

6.3. Service Operation

Distribution

For an embedded application, the only possible distribution channel is the OEM's app store. Others can be distributed through traditional smartphone channels.

Customer Relationship

For some Connected Car services, it is important to gain and maintain the customers' trust when it comes to data privacy issues. Therefore, communication on a regular basis is advisable. This could, for example, be through a quarterly update of data usage. For services designed to be executed over a period of years, it is important to stay in the subscribers' awareness.

Service Updates

In order to keep up with technological evolution throughout the entire lifecycle of the car, it is important to react to infrastructural changes and consistently improve the connected car application. The improvements should be brought to the customer via over-the-air updates, which ensures the most convenient user experience.

7. Future Roadmap

The rapid increase of connected car service offerings over the next years is demanded by customers, mandated by authorities and forecasted by various studies. This section identifies and discusses market drivers and barriers in order to develop an outlook of future development.

Clearly, one of the biggest drivers for car innovations in general is driver and passenger safety. The introduction of safety innovations like the seatbelt, the airbag and the electronic stability program were widely accepted from the start and sparked consumer demand for safety. Now, car developers have found a solution for taking safety to the next level by making use of information technology. The connected car opens safety opportunities by not only decreasing the health hazard in case of an accident (eCall) but also even lowering the risk of an accident through communicating with other traffic elements and infrastructures. The awareness of these possibilities is one of the key factors for the OEMs to overcome privacy concerns amongst potential customers. In addition to an increase in driving safety, the OEMs can convincingly argue that connected car services have the potential to enhance energy efficiency and driving experience, by avoiding traffic jams and being able to provide the most fuel-efficient route. This consequently leads to lower emissions and cost savings for the customer, which are top-priority decision factors for modern car buyers.

Besides customer-related market drivers, there is also the important financial aspect of the decreasing costs for connectivity. This downward trend is necessary to make the connected car affordable and suitable for the mass-market but it will also have an effect on car purchases. In America, AT&T is letting GM's OnStar subscribers add their vehicles to their data plans, along with their smartphones and tablets. The customer's mobile network may thus affect the choice of car. In a recent survey, Nielsen, a market-research company, found that half of Americans who owned cars made since 2009 would be less likely to buy a new car if it had a different data plan from their smartphone.

The decision of dictating a fully-functional eCall service for all new car models and light commercial vehicles by the European Commission will provide the E.U. with a real advantage with respect to establishing the connected car market. Offering the eCall service involves installing connectivity devices into those vehicles and in this way acts as market-maker and icebreaker in terms of price. In addition to the E.U., Brazil and Russia are also beginning to mandate the fitting of embedded telematics for safety issues.

Despite various market drivers, there are also barriers that have prevented the ultimate breakthrough of the connected car in the past few years. One of these is the fact that customers are reluctant to pay the extra costs associated with embedded connectivity and instead use their smartphones as a solution for their in-car connectivity needs. Because this barrier is likely to continue in the short-term, car manufacturers are justifiably turning to smartphone integration in an effort to satisfy consumer demand for connectivity, as analyzed earlier in this report.

The long product lifecycle of a car, compared to the rapid technological evolution in the telecommunications business, acts as a considerable market barrier, especially for embedded systems. In the modern consumer society there is a high demand for keeping up with technological developments. For this reason, software and hardware updates will play an important role in the future development of the connected car market.

Connected car users could easily be deterred by looking at the immense amount of available and potential connected car applications and services. This effect is especially intensified if user interfaces and connectivity setup requirements are too complex or hard to operate. The number one priority for connected car applications is to enhance the driving experience by decreasing driver

distraction. In order to achieve this challenging goal, HMI solutions must consistently be evaluated and optimized. It is immensely important that customers feel safe when using connected car services. This safety does not only relate to the driving action but also to data privacy issues. According to a customer survey[16], 37 % of new car buyers are reluctant to use car-related connected services because of privacy reasons. The survey shows a strong region-specific variation (Germany: 51%, China: 21%). It is unquestionable that the industry has to work on overcoming this concern by providing safe and reliable products.

From the perspective of the Connected Car service development, in the coming years all OEMs are likely to join the strategy of opening the platform allowing third parties to develop car apps capable of accessing car data. The amount of Car Apps of open platforms will grow faster as enterprises start developing services around the Connected Car. Open platforms reduce the time-to-market of services to be developed and therefore the potential Car App ecosystem will be in the near future a new factor that may influence the customer on the decision-making process of purchasing a car, which will benefit OEMs with open platforms. Those OEMs with closed or partnered platforms will have to rethink their strategies soon.

The captured information can help both customers and enterprises to establish a C2B relationship. Pay how you drive and Pay as you drive business models are the most obvious ones. The cost-saving benefits for the customers will probably revert in a behavior change of the driver with a positive impact on traffic safety as well. The success of new business models will probably increase the demand and detail of data. Likewise, new car equipment allowing new capabilities (such as Vehicle2X communications) will require enriching the type of car data that can be accessed. In addition, the success of new business around the Connected Car platforms will require consuming more detailed data in order to improve future business operations.

7.1. 2025 Forecast

The fact that car connectivity will become omnipresent in the next ten years is beyond doubt. Companies planning on positioning themselves on the connected car market should have a clear view on which connectivity architecture to choose. This will not only affect the service design but also distribution and revenue channels. According to market research[17], many cars will continue to have multiple forms of connectivity during the next ten years, despite the fact that embedded solutions will become significantly more appealing and affordable. However, the tethering solution is expected to decline in importance, giving space to the more user-friendly embedded solutions. Tethered connectivity is seen as a short-term solution to meet customers' unwillingness to pay for a second communication subscription, on top of their mobile phone contracts. This eventual sales peak at the end of the decade is not foreseen for integrated systems, due to the still-growing importance of smartphones and apps. In addition, the increasing computing power of smartphones has considerable influence. These trends can significantly differ across different regions and markets.

[16] McKinsey's Connected Car Consumer Survey, 2014
[17] SBD/GSMA, "2025 Every Car Connected: Forecasting the Growth and Opportunity"

8. Summary and Strategic Recommendations

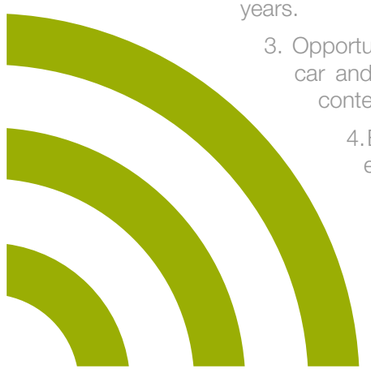
With the connected car we are at the moment heading to an entirely new way of approaching car usage and ownership, ultimately leading to a fundamental change in industry structure. We are currently seeing all major OEMs establishing and offering connected services on all important markets across the globe. In-car connectivity can be achieved either through an embedded communication module, a tethered system which requires access to an external SIM or through smartphone integration. The applicability of each connectivity solution depends on the particular service in question. The solutions are not mutually exclusive and can be used simultaneously in the same vehicle. There is already a broad range of connected service applications offered, from various fields such as safety, infotainment, traffic or convenience. Some OEMs started to include third-party developers into their application development process by establishing platforms and providing them with extensive real-time vehicle data. Within the scope of this report, a case study is presented which is executed in a three-stage process and aims to identify opportunities and challenges for third-party content providers in the connected car market.

> *The automobile's best days are yet to come.*
>
> Dieter Zetsche, CEO Daimler AG

For car manufacturers, the connected car has the potential to significantly boost revenues in the next five to seven years and to establish closer, more profitable connections with customers. Technologically speaking, a lot is already feasible when it comes to connected car applications that enhance the driving and car owning experience. Of course, car manufacturers are well-advised to systematically invest in specific research and development, in order to gain or maintain their technological leadership, but ultimately it will not be merely a matter of technology alone. Car manufacturers must figure out the right way to bring together users and third-party content providers, in order to be able to offer their customers the kind of connected experience they demand. Considerable attention must also be paid to how services can be bundled and offered to the right customer segment. There is no doubt about the fact that connectivity will bring customers and carmakers closer together. Companies must be clear about what this means for how they do business and take advantage of this development.

The growth of the connected car market presents a potential for car manufacturers but also to content providers from various business fields. Companies offering services via mobile smartphone applications should especially consider extending their competences to in-vehicle services. In this context, four reasons can be given for a company to offer an automotive app:

1. Market is not yet crowded. Early movers can claim their market space.
2. Long life-cycle and revenue. A car involves a long relationship owned for many years.
3. Opportunity for additional sales. People spend a lot of time in the car and this is a good opportunity to engage them with specific content.
4. Enjoy higher brand loyalty. Due to the special nature of the driving experience.



The connected car market puts industry players in a promising yet challenging position, due to the fact that customers demand connectivity but have security doubts and are only partially willing to pay for it. Even though the future revenue potential for the connectivity-enabled car is immense, companies will face tough and precarious decisions.

ANNEX

Audi

		A1, A4, A5, A6, A7, A8, Q3, Q5, Q7	A3	A6, A7 (a)	TT
Traffic Safety	Remote Diagnostics	◑	◑	◑	◑
	Stolen Vehicle Assistance	○	○	○	○
	Geofencing/Speed Monitoring	○	○	○	○
	Smart SOS	◑	◑	◑	◑
	Roadside Assistance	◑	◑	◑	◑
Connected Infotainment	Internet Browser	○	○	○	○
	Wi-Fi Hotspot	●	●	●	●
	News Feed	◑	●	●	●
	Music Stream				
	Email				
	Social Media	◑	●	●	●
	App-Store	○	○	○	○
Traffic Efficiency	Street View (Google)	●	●	●	●
	Traffic Info	●	●	●	●
	Online Route Planning (b)	●	●	●	●
	Parking Infos	●	●	●	●
Cost Efficiency	Insurance Telematics (UBI)	○	○	○	○
	Driver Behavior Monitoring	○	○	○	○
	Real-time Fuel Prices	?	?	?	?
	Electric Vehicle Charging	○	○	○	○
	Predictive Maintenance	◑	◑	◑	◑
	Eco Tax	○	○	○	○
Convenience and Interaction	Call center	○	○	○	○
	Remote Services	○	○	○	○
	Electronic Toll Collection	○	○	○	○
	Personal Online Platform	●	●	●	●
	Car sharing	●	●	●	●

● Implemented

◑ Planned

○ Not offered

(a) From model year 2015 onwards

(b) Also available for vehicles with MMI Navigation System plus without Audi connect.

BMW

		S. 1, 2, 3, 4, 5, 6, 7, X1, X3, X4, X5, X6, Z4	i3,i8
Traffic Safety	Remote Diagnostics	●	●
	Stolen Vehicle Assistance	◑	◑
	Geofencing/Speed Monitoring	●	●
	Smart SOS	●	●
	Roadside Assistance	●	●
Connected Infotainment	Internet Browser	●	●
	Wi-Fi Hotspot	●	●
	News Feed	●	●
	Music Stream	●	●
	Email	●	●
	Social Media	●	●
	App-Store	●	●
Traffic Efficiency	Street View (Google)	○	○
	Traffic Info	●	●
	Online Route Planning	○	○
	Parking Infos	●	●
Cost Efficiency	Insurance Telematics (UBI)	◑	◑
	Driver Behavior Monitoring	○	○
	Real-time Fuel Prices	●	●
	Electric Vehicle Charging	○	●
	Predictive Maintenance	●	●
	Eco Tax	○	○
Convenience and Interaction	Call center	●	●
	Remote Services	●	●
	Electronic Toll Collection	○	○
	Personal Online Platform	●	●
	Car sharing	●	●

● Implemented

◑ Planned

○ Not offered

Mercedes

		A Class	B Class	C Class	CLA Class	CLS Class	E Class	G Class	GL Class	GLA Class	GLE Class	GLK Class	M Class	S Class	SL Class	SLK Class	AMG GT
Traffic Safety	Remote Diagnostics	○	●	●	●	●	○	○	○	○	●	○	○	●	○	○	●
	Stolen Vehicle Assistance	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑
	Geofencing/Speed Monitoring	○	●	●	●	●	○	○	○	○	●	○	○	●	○	○	●
	Smart SOS	○	●	●	●	●	○	○	○	○	●	○	○	●	○	○	●
	Roadside Assistance	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Connected Infotainment	Internet Browser	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Wi-Fi Hotspot	○	○	○	○	●	○	○	●	○	○	○	●	●	○	○	○
	News Feed	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Music Stream	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Email	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑
	Social Media	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	App-Store	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Traffic Efficiency	Street View (Google)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Traffic Info	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Online Route Planning	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Parking Infos	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑
Cost Efficiency	Insurance Telematics (UBI)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Driver Behavior Monitoring	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Real-time Fuel Prices	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑
	Electric Vehicle Charging	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Predictive Maintenance	○	●	●	●	●	○	○	○	○	●	○	○	●	○	○	●
	Eco Tax	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Convenience and Interaction	Call center	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Remote Services	○	●	●	●	●	○	○	○	○	●	○	○	●	○	○	●
	Electronic Toll Collection	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Personal Online Platform	○	●	●	●	●	○	○	○	○	●	○	○	●	○	○	●
	Car sharing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

● Implemented

◑ Planned

○ Not offered

Ford

		Ka	Fiesta	B-Max	Ecosport	Focus	C-Max	Kuga	Mondeo	Mustang	S-Max	Galaxy
Traffic Safety	Remote Diagnostics	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑
	Stolen Vehicle Assistance	○	○	○	○	○	○	○	○	○	○	○
	Geofencing/Speed Monitoring	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑
	Smart SOS	○	●	○	●	●	●	●	●	●	○	○
	Roadside Assistance	○	○	○	○	○	○	○	○	○	○	○
Connected Infotainment	Internet Browser	○	○	○	○	○	○	○	○	○	○	○
	Wi-Fi Hotspot	○	○	○	○	○	○	○	○	○	○	○
	News Feed	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑
	Music Stream	○	●	○	●	●	●	●	●	●	○	○
	Email	○	○	○	○	○	○	○	○	○	○	○
	Social Media	○	○	○	○	○	○	○	○	○	○	○
	App-Store	○	●	○	●	●	●	●	●	●	○	○
Traffic Efficiency	Street View (Google)	○	○	○	○	○	○	○	○	○	○	○
	Traffic Info	○	●	○	●	●	●	●	●	●	○	○
	Online Route Planning	○	○	○	○	○	○	○	○	○	○	○
	Parking Infos	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑
Cost Efficiency	Insurance Telematics (UBI)	○	○	○	○	○	○	○	○	○	○	○
	Driver Behavior Monitoring	○	○	○	○	○	○	○	○	○	○	○
	Real-time Fuel Prices	○	○	○	○	○	○	○	○	○	○	○
	Electric Vehicle Charging	○	○	○	○	○	○	○	○	○	○	○
	Predictive Maintenance	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑
	Eco Tax	○	○	○	○	○	○	○	○	○	○	○
Convenience and Interaction	Call center	○	○	○	○	○	○	○	○	○	○	○
	Remote Services	○	○	○	○	○	○	○	○	○	○	○
	Electronic Toll Collection	○	○	○	○	○	○	○	○	○	○	○
	Personal Online Platform	○	●	○	●	●	●	●	●	●	○	○
	Car sharing	●	●	●	●	●	●	●	●	●	●	●

● Implemented

◑ Planned

○ Not offered

Nissan

		Leaf	Micra, Note, Juke, Pulsar, Qashqai, X-Trail, Murano
Traffic Safety	Remote Diagnostics	○	○
	Stolen Vehicle Assistance	○	○
	Geofencing/Speed Monitoring	○	○
	Smart SOS	◑	◑
	Roadside Assistance	○	○
Connected Infotainment	Internet Browser	○	○
	Wi-Fi Hotspot	○	○
	News Feed	●	●
	Music Stream	●	●
	Email	○	○
	Social Media	●	●
	App-Store	●	●
Traffic Efficiency	Street View (Google)	○	○
	Traffic Info	●	●
	Online Route Planning	●	●
	Parking Infos	○	○
Cost Efficiency	Insurance Telematics (UBI)	○	○
	Driver Behavior Monitoring	●	○
	Real-time Fuel Prices	◑	◑
	Electric Vehicle Charging	●	○
	Predictive Maintenance	○	○
	Eco Tax	○	○
Convenience and Interaction	Call center	○	○
	Remote Services	○	○
	Electronic Toll Collection	○	○
	Personal Online Platform	●	●
	Car sharing	○	○

● Implemented

◑ Planned

○ Not offered

Opel

		Adam, Corsa, Meriva, Astra, Insignia, Mokka, Cabrio	Zafira	Ampera	Antara
Traffic Safety	Remote Diagnostics	●	●	●	●
	Stolen Vehicle Assistance	●	●	●	●
	Geofencing/Speed Monitoring	●	●	●	●
	Smart SOS	●	●	●	●
	Roadside Assistance	●	●	●	●
Connected Infotainment	Internet Browser	○	○	○	○
	Wi-Fi Hotspot	●	●	●	●
	News Feed	○	○	○	○
	Music Stream	●	○	○	○
	Email	○	○	○	○
	Social Media	◑	○	○	○
	App-Store	●	○	○	○
Traffic Efficiency	Street View (Google)	○	○	○	○
	Traffic Info	●	○	●	●
	Online Route Planning	●	●	●	●
	Parking Infos	○	○	○	○
Cost Efficiency	Insurance Telematics (UBI)	◑	◑	◑	◑
	Driver Behavior Monitoring	○	○	○	○
	Real-time Fuel Prices	○	○	○	○
	Electric Vehicle Charging	○	○	●	○
	Predictive Maintenance	●	●	●	●
	Eco Tax	○	○	○	○
Convenience and Interaction	Call center	●	●	●	●
	Remote Services	●	●	●	●
	Electronic Toll Collection	○	○	○	○
	Personal Online Platform	●	●	●	●
	Car sharing	●	●	●	●

● Implemented

◑ Planned

○ Not offered

Peugeot

		108	208	308	508	2008	3008	4008	5008	iOn	508 RXH
Traffic Safety	Remote Diagnostics	○	●	●	●	●	●	●	●	●	●
	Stolen Vehicle Assistance	○	○	○	○	○	○	○	○	○	○
	Geofencing/Speed Monitoring	○	●	●	●	●	●	●	●	●	●
	Smart SOS	○	●	●	●	●	●	●	●	●	●
	Roadside Assistance	○	●	●	●	●	●	●	●	●	●
Connected Infotainment	Internet Browser	○	○	○	○	○	○	○	○	○	○
	Wi-Fi Hotspot	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑
	News Feed	○	○	○	○	○	○	○	○	○	○
	Music Stream	○	●	●	●	●	○	○	○	○	○
	Email	○	●	●	●	●	○	○	○	○	○
	Social Media	○	●	●	●	●	○	○	○	○	○
	App-Store	○	●	●	●	●	○	○	○	○	○
Traffic Efficiency	Street View (Google)	○	○	○	○	○	○	○	○	○	○
	Traffic Info		●	●	●	●	●	●	●	●	●
	Online Route Planning	○	○	○	○	○	○	○	○	○	○
	Parking Infos	○	●	●	●	●	○	○	○	○	○
Cost Efficiency	Insurance Telematics (UBI)	○	○	○	○	○	○	○	○	○	○
	Driver Behavior Monitoring	○	○	○	○	○	○	○	○	○	○
	Real-time Fuel Prices	○	●	●	●	●	○	○	○	○	○
	Electric Vehicle Charging	○	○	○	○	○	○	○	○	●	○
	Predictive Maintenance	○	●	●	●	●	○	○	○	○	○
	Eco Tax	○	○	○	○	○	○	○	○	○	○
Convenience and Interaction	Call center	○	○	○	○	○	○	○	○	○	○
	Remote Services	○	○	○	○	○	○	○	○	○	○
	Electronic Toll Collection	○	○	○	○	○	○	○	○	○	○
	Personal Online Platform	●	●	●	●	●	●	●	●	●	●
	Car sharing	●	●	●	●	●	●	●	●	●	●

● Implemented

◑ Planned

○ Not offered

Renault

		Twingo	Clio	Captur	Megane	Fluence	Scenic	Laguna	Espace	Koleos	Twizy	Zoe
Traffic Safety	Remote Diagnostics	●	●	●	●	●	●	●	●	●	○	●
	Stolen Vehicle Assistance	○	○	○	○	○	○	○	○	○	○	○
	Geofencing/Speed Monitoring	○	○	○	○	○	○	○	○	○	○	○
	Smart SOS	◑	◑	◑	◑	◑	◑	◑	◑	◑	○	◑
	Roadside Assistance	●	●	●	●	●	●	●	●	●	○	●
Connected Infotainment	Internet Browser	○	○	○	○	○	○	○	○	○	○	○
	Wi-Fi Hotspot	○	○	○	○	○	○	○	○	○	○	○
	News Feed	●	●	●	●	●	●	●	●	●	○	●
	Music Stream	○	○	○	○	○	○	○	○	○	○	○
	Email	●	●	●	●	●	●	●	●	●	○	●
	Social Media	●	●	●	●	●	●	●	●	●	○	●
	App-Store	●	●	●	●	●	●	●	●	●	○	●
Traffic Efficiency	Street View (Google)	○	○	○	○	○	○	○	○	○	○	○
	Traffic Info	●	●	●	●	●	●	●	●	●	○	●
	Online Route Planning	●	●	●	●	●	●	●	●	●	○	●
	Parking Infos	●	●	●	●	●	●	●	●	●	○	●
Cost Efficiency	Insurance Telematics (UBI)	○	○	○	○	○	○	○	○	○	○	○
	Driver Behavior Monitoring	●	●	●	●	●	●	●	●	●	○	●
	Real-time Fuel Prices	●	●	●	●	●	●	●	●	●	○	●
	Electric Vehicle Charging	○	○	○	○	○	○	○	○	○	○	○
	Predictive Maintenance	◑	◑	◑	◑	◑	◑	◑	◑	◑	○	◑
	Eco Tax	○	○	○	○	○	○	○	○	○	○	○
Convenience and Interaction	Call center	○	○	○	○	○	○	○	○	○	○	○
	Remote Services	○	○	○	○	○	○	○	○	○	○	○
	Electronic Toll Collection	○	○	○	○	○	○	○	○	○	○	○
	Personal Online Platform	●	●	●	●	●	●	●	●	●	○	●
	Car sharing	○	○	○	○	○	○	○	○	○	○	○

● Implemented

◑ Planned

○ Not offered

Toyota

		Aygo	Yaris	Auris	Prius	Verso	Avensis	GT86	RAV4	Land Cruiser	Hilux
Traffic Safety	Remote Diagnostics	○	○	○	○	○	○	○	○	○	○
	Stolen Vehicle Assistance	○	○	○	○	○	○	○	○	○	○
	Geofencing/Speed Monitoring	○	○	○	○	○	○	○	○	○	○
	Smart SOS	●	●	●	●	●	●	●	●	●	●
	Roadside Assistance	○	○	○	○	○	○	○	○	○	○
Connected Infotainment	Internet Browser	○	○	○	○	○	○	○	○	○	○
	Wi-Fi Hotspot	○	○	○	○	○	○	○	○	○	○
	News Feed	○	○	○	○	○	○	○	○	○	○
	Music Stream	●	●	●	●	●	●	●	●	●	●
	Email	●	●	●	●	●	●	●	●	●	●
	Social Media	●	●	●	●	●	●	●	●	●	●
	App-Store	○	○	○	○	○	○	○	○	○	○
Traffic Efficiency	Street View (Google)	●	●	●	●	●	●	●	●	●	●
	Traffic Info	●	●	●	●	●	●	●	●	●	●
	Online Route Planning	●	●	●	●	●	●	●	●	●	●
	Parking Infos	●	●	●	●	●	●	●	●	●	●
Cost Efficiency	Insurance Telematics (UBI)	○	○	○	○	○	○	○	○	○	○
	Driver Behavior Monitoring	○	○	○	○	○	○	○	○	○	○
	Real-time Fuel Prices	●	●	●	●	●	●	●	●	●	●
	Electric Vehicle Charging	○	○	○	○	○	○	○	○	○	○
	Predictive Maintenance	○	○	○	○	○	○	○	○	○	○
	Eco Tax	○	○	○	○	○	○	○	○	○	○
Convenience and Interaction	Call center	○	○	○	○	○	○	○	○	○	○
	Remote Services	○	○	○	○	○	○	○	○	○	○
	Electronic Toll Collection	○	○	○	○	○	○	○	○	○	○
	Personal Online Platform	●	●	●	●	●	●	●	●	●	●
	Car sharing	○	○	○	○	○	○	○	○	○	○

● Implemented

◑ Planned

○ Not offered

Annex

Volkswagen

		up!	e-up!	Polo	Golf	e-Golf	Beetle	Sirocco	Jetta	Passat	CC	Touran	Sharan	Tiguan	Touareg	Phaeton
Traffic Safety	Remote Diagnostics	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑
	Stolen Vehicle Assistance	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑
	Geofencing/Speed Monitoring	○	○	●	○	○	●	○	○	●	○	●	○	○	○	○
	Smart SOS	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑
	Roadside Assistance	○	○	●	○	○	●	○	○	●	○	●	○	○	○	○
Connected Infotainment	Internet Browser	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Wi-Fi Hotspot	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑
	News Feed	○	○	○	○	○	●	○	○	●	○	●	○	○	○	○
	Music Stream	○	○	●	○	○	●	○	○	●	○	●	○	○	○	○
	Email	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Social Media	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	App-Store	●	●	○	○	○	○	○	○	○	○	○	○	○	○	○
Traffic Efficiency	Street View (Google)	○	○	○	●	●	●	○	○	●	○	●	○	○	●	○
	Traffic Info	●	●	●	●	●	●	○	○	●	○	●	○	○	●	○
	Online Route Planning	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑
	Parking Infos	○	○	●	○	○	●	○	○	●	○	●	○	○	○	○
Cost Efficiency	Insurance Telematics (UBI)	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑	◑
	Driver Behavior Monitoring	●	●	●	○	○	●	○	○	●	○	●	○	○	○	○
	Real-time Fuel Prices	○	○	○	○	○	○	○	○	●	○	●	○	○	○	○
	Electric Vehicle Charging	○	●	○	○	●	○	○	○	○	○	○	○	○	○	○
	Predictive Maintenance	○	○	○	○	○	●	○	○	●	○	●	○	○	○	○
	Eco Tax	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Convenience and Interaction	Call center	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Remote Services	○	○	●	●	●	○	○	○	○	○	○	○	○	○	○
	Electronic Toll Collection	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
	Personal Online Platform	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Car sharing	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

● Implemented

◑ Planned

○ Not offered

Argentina
Belgium
Brazil
Colombia
Chile
Italy
Mexico
Peru
Portugal
Spain
UK
USA

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